

## WHAT IS CLAIMED IS:

1. A reactor system for synthesizing a plurality of polymer sequences on a substrate comprising:

5 a) a reactor for contacting reaction fluids to said substrate;

b) a system for delivering selected reaction fluids to said reactor;

10 c) a translation stage for moving a mask or substrate from at least a first relative location relative to a second relative location;

d) a light for illuminating said substrate through a mask at selected times; and

15 e) an appropriately programmed digital computer for selectively directing a flow of fluids from said reactor system, selectively activating said translation stage, and selectively illuminating said substrate so as to form a plurality of diverse polymer sequences on said substrate at predetermined locations.

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2. The reactor system as recited in claim 1 adapted to provide a plurality of monomers in a reaction fluid to said substrate, said substrate used for an initial screening of polymer sequences.

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3. An ordered method for forming a plurality of polymer sequences by sequential addition of reagents comprising the step of serially protecting and deprotecting portions of said plurality of polymer sequences for addition of other portions of said polymer sequences using a binary synthesis strategy.

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4. The method as recited in claim 3 wherein said binary synthesis strategy is a binary masking strategy.

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5. The method as recited in claim 4 wherein said masking strategy in which said masking strategy provides

at least two consecutive steps in which a mask factors a previous mask by protecting a portion of a previously illuminated portions to light and exposing a portion of a previously protected portions to light.

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6. The method as recited in claim 4 in which said masking strategy in which at least two successive steps in said masking strategy illuminate about one half of a region of interest on said substrate.

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7. The method as recited in claim 4 wherein said masking strategy forms a plurality of polymer sequences on a single substrate.

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8. The method as recited in claim 4 wherein said masks are arranged in a gray code masking scheme, said gray code masking scheme having one edge illumination on each of a plurality of synthesis sites.

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9. The method as recited in claim 4 wherein said masking scheme results in a minimum number of masking steps for a number of polymers synthesized.

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10. The method as recited in claim 4 wherein all possible polymers of length 1 are formed with a given basis set of monomers.

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11. The method as recited in claim 4 wherein said masking strategy is developed in an appropriately programmed digital computer inputting at least a desired basis set, and length of polymers.

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12. The method as recited in claim 4 wherein all possible polymers of a length less than or equal to 1 are formed with a given basis set of monomers.

13. The method as recited in claim 4 further comprising the step of forming a portion of said polymers with a non-binary masking scheme.

5        14. The method as recited in claim 10 further comprising the step of outputting a masking strategy.

10       15. The method as recited in claim 10 further comprising the step of outputting a map of synthesized polymers on said substrate.

16. The method as recited in claim 15 wherein said map is in the form of Fig. 10.

15       17. A method of screening a plurality of linker polymers for use in binding affinity studies comprising the steps of:

20       a) forming a plurality of linker polymers on a substrate in selected regions, said linker polymers formed by the steps of recursively:

      i) on a surface of a substrate, irradiating a portion of said selected regions to remove a protective group; and

      ii) contacting said surface with a monomer;

25       b) contacting said plurality of linker polymers with a ligand; and

      c) contacting said ligand with a labeled receptor.

30       18. The method as recited in claim 17 wherein said ligand is a polypeptide.

19. The method as recited in claim 17 wherein said receptor is an antibody.

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20. The method as recited in claim 17 wherein said monomers added in step ii) are the same in each of said

recursive steps, said selected regions comprising linker molecules of different lengths.

21. The method as recited in claim 17 wherein said  
5 labelled receptor is a fluoresceinated receptor.

22. A system for determining affinity of a receptor to a ligand comprising:

10 a) means for applying light to a surface of a substrate, said substrate comprising a plurality of ligands at predetermined locations, said means for applying directing light providing simultaneous illumination at a plurality of said predetermined locations; and

15 b) an array of detectors for detecting light fluoresced at said plurality of predetermined locations.

23. A system as recited in claim 22 wherein said means for applying light comprises a point light source  
20 and a cylindrical lens for focusing said point light source along a substantially linear path.

24. A system as recited in claim 22 wherein said array of detectors comprises a linear array.

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25. A system as recited in claim 22 wherein said array of detectors comprises a linear CCD array.

26. In a digital computer, a method of determining  
30 the tendency of a receptor to bind to a ligand comprising:

a) exposing fluorescently labelled receptors to a substrate, said substrate comprising a plurality of ligands in regions at known locations;

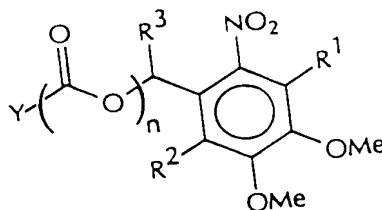
35 b) at a plurality of data collection points within each of said regions, determining an amount of light fluoresced from said data collection points;

c) removing said data collection points deviating from a preset amount from a predetermined statistical distribution; and

d) determining a relative binding affinity of said receptor to remaining data collection points.

27. The method as recited in claim 26 wherein said predetermined statistical distribution is a normal distribution.

28. A compound having the formula:



wherein  $n = 0$  or  $1$ ;  $Y$  is selected from the group consisting of an oxygen of the carboxyl group of a natural or unnatural amino acid, an amino group of a natural or unnatural amino acid, or the C-5' oxygen group of a natural or unnatural deoxyribonucleic or ribonucleic acid;  $R^1$  and  $R^2$  independently are a hydrogen atom, a lower alkyl, aryl, benzyl, halogen, hydroxyl, alkoxyl, thiol, thioether, amino, nitro, carboxyl, formate, formamido, sulfido, or phosphido group; and  $R^3$  is a alkoxy, alkyl, aryl, hydrogen, or alkenyl group.

29. The compound of claim 28 wherein  $Y$  is the C-5' oxygen group of a natural or unnatural deoxyribonucleic or ribonucleic acid.

30. The compound of claim 29 wherein  $n = 0$ .

31. The compound of claim 29 wherein  $R^1$  and  $R^2$  are each a hydrogen atom.

32. The compound of claim 31 wherein  $R^3$  is a hydrogen atom.

33. The compound of claim 31 wherein  $R^3$  is a methyl group.

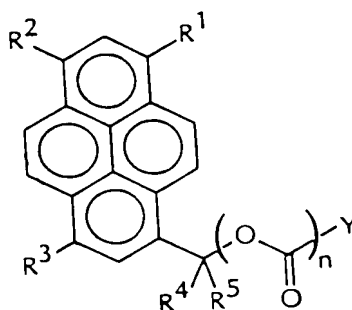
34. The compound of claim 28 wherein Y is an oxygen of the carboxyl group of an amino acid and  $n = 0$ .

35. The compound of claim 34 wherein  $R^1$  and  $R^2$  are each a hydrogen atom.

36. The compound of claim 35 wherein  $R^3$  is a hydrogen atom.

37. The compound of claim 35 wherein  $R^3$  is a methyl group.

38. A compound having the formula:



wherein  $n = 0$  or  $1$ ; Y is selected from the group consisting of an amino group of a natural or unnatural amino acid or the C-5' oxygen group of a natural or unnatural deoxyribonucleic and ribonucleic acid;  $R^1$ ,  $R^2$ , and  $R^3$  independently are a hydrogen atom, a lower alkyl, aryl, benzyl, halogen, hydroxyl, alkoxyl, thiol, thioether, amino, nitro, carboxyl, formate, formamido, sulfido or phosphido group;  $R^4$  and  $R^5$  independently are a

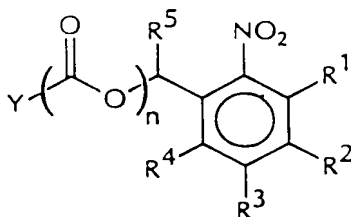
alkoxy, alkyl, hydrogen, halo, aryl, hydrogen, or alkenyl group.

39. The compound of claim 38 wherein  $R^1$  through  $R^3$  are each a hydrogen atom.

40. The compound of claim 39 wherein  $R^4$  and  $R^5$  are each a hydrogen atom.

41. The compound of claim 39 wherein  $R^4$  and  $R^5$  are each a methyl group.

42. A compound having the formula:



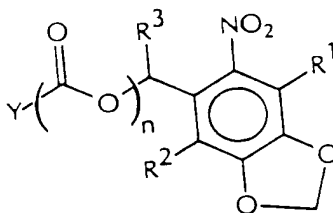
wherein  $n = 0$  or  $1$ ;  $Y$  is a C-5' oxygen group of a natural or unnatural deoxyribonucleic and ribonucleic acid;  $R^1$  through  $R^4$  independently are a hydrogen atom, a lower alkyl, aryl, benzyl, halogen, hydroxyl, alkoxyl, thiol, thioether, amino, nitro, carboxyl, formate, formamido, sulfido, or phosphido group; and  $R^5$  is a alkoxy, alkyl, aryl, or alkenyl group.

43. The compound of claim 42 wherein  $R^2$  and  $R^3$  are each a methoxy group.

44. The compound of claim 43 wherein  $R^1$  and  $R^4$  are each a hydrogen atom.

45. The compound of claim 44 wherein  $R^5$  is a methyl group.

46. A compound having the formula:



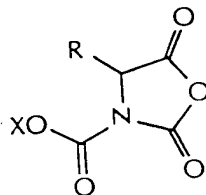
wherein  $n = 0$  or  $1$ ;  $Y$  is an atom to be protected;  $R^1$  and  $R^2$  independently are a hydrogen atom, a lower alkyl, aryl, benzyl, halogen, hydroxyl, alkoxy, thiol, thioether, amino, nitro, carboxyl, formate, formamido, sulfido, or phosphido group; and  $R^3$  is a alkoxy, alkyl, aryl, or alkenyl group.

47. The compound of claim 46 wherein  $Y$  is selected from the group consisting of an oxygen of the carboxyl group of a natural or unnatural amino acid, or the C-5' oxygen group of a natural or unnatural deoxyribonucleic or ribonucleic acid, or the amino group of a natural or unnatural amino acid.

48. The compound of claim 47 wherein  $R^1$  and  $R^2$  are hydrogen.

49. The compound of claim 48 wherein  $R^3$  is a methyl group.

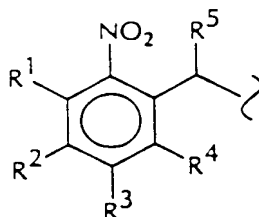
50. A compound having the formula:





where R is a side chain of a natural or unnatural amino acid and X is a photoremovable protecting group.

51. The compound of claim 50 wherein X has the  
5 following formula:



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where R<sup>1</sup>, R<sup>2</sup>, R<sup>3</sup>, and R<sup>4</sup> independently are a hydrogen atom,  
a lower alkyl, aryl, benzyl, halogen, hydroxyl, alkoxyl,  
15 thiol, thioether, amino, nitro, carboxyl, formate,  
formamido or phosphido group, or adjacent substituents  
are substituted oxygen groups that together form a cyclic  
acetal or ketal; and R<sup>5</sup> is a hydrogen atom, a alkoxyl,  
alkyl, hydrogen, halo, aryl, or alkenyl group.

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52. The compound of claim 51 wherein R<sup>1</sup> and R<sup>4</sup> are  
each a hydrogen atom, and R<sup>2</sup> and R<sup>3</sup> are each a methoxy  
group.

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53. The compound of claim 52 wherein R<sup>5</sup> is a methyl  
group.

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54. The compound of claim 51 wherein R<sup>2</sup> and R<sup>3</sup> are  
substituted oxygen groups that together form a cyclic  
acetal.

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55. The compound of claim 54 wherein R<sup>1</sup> and R<sup>4</sup> are  
each a hydrogen atom.

56. The compound of claim 55 wherein R<sup>5</sup> is a methyl  
group.